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Review article

Chemical contaminants in feedlot wastes: Concentrations, effects and attenuation

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Abstract

Commercial feedlots for beef cattle finishing are potential sources of a range of trace chemicals which have human health or environmental significance. To ensure adequate protection of human and environmental health from exposure to these chemicals, the application of effective manure and effluent management practices is warranted. The Australian meat and livestock industry has adopted a proactive approach to the identification of best management practices. Accordingly, this review was undertaken to identify key chemical species that may require consideration in the development of guidelines for feedlot manure and effluent management practices in Australia. Important classes of trace chemicals identified include steroidal hormones, antibiotics, ectoparasiticides, mycotoxins, heavy metals and dioxins. These are described in terms of their likely sources, expected concentrations and public health or environmental significance based on international data and research. Androgenic hormones such as testosterone and trenbolone are significantly active in feedlot wastes, but they are poorly understood in terms of fate and environmental implications. The careful management of residues of antibiotics including virginiamycin, tylosin and oxytetracycline appears prudent in terms of minimising the risk of potential public health impacts from resistant strains of bacteria. Good management of ectoparasiticides including synthetic pyrethroids, macrocyclic lactones, fluazuron, and amitraz is important for the prevention of potential ecological implications, particularly towards dung beetles. Very few of these individual chemical contaminants have been thoroughly investigated in terms of concentrations, effects and attenuation in Australian feedlot wastes.

Keywords: Feedlots; Hormones; Antibiotics; Ectoparasiticides; Waste management

Contents

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1. Introduction

The Australian meat and livestock industry has adopted a proactive stance towards the implementation of best practices for the management of chemical contaminants that may be present in manure and effluent from commercial feedlot operations. While numerous activities will be necessary to achieve this, the first requirement is the identification of chemicals likely to warrant closest scrutiny. This review of primarily international data and research was undertaken to identify key chemicals for which local analytical efforts appear most justified.

Commercial feedlots are a major method of finishing beef cattle in preparation for slaughter in Australia. Cattle entering feedlots are typically 12–24 months of age. Depending on the intended market for the cattle, they may be fed for 60 days to up to 400 days while gaining about 100–350 kg in weight.

The main by-products from cattle feedlots are the manure harvested from the surface of the pens and liquid effluent collected during rainfall runoff events. A typical animal entering a feedlot (e.g. 340 kg for heavier markets) produces approximately 20 kg of manure per day, increasing to up to 36 kg manure per day for a heavy finished animal (600 kg). Fresh manure, which comprises of faeces and urine, is normally composed of around 90% water and 10% solids.

Good feedlot pad management requires a balance between environmental and animal health considerations and the economic cost of pen cleaning. However, the period of time between pen cleanings generally means that there is some decomposition of pad manure before it is removed from the pen.

Depending on variations in management and weather, manure harvesting rates have been reported to vary between 0.41–1.05 t dry weight per head per year (Lott et al., 1994).

While manure harvesting from pens occurs at regular intervals, manure spreading or dispatch offsite depends upon management methods, weather conditions and cropping cycles which influence when manure can be spread or sold. Accordingly, manure is often stockpiled at feedlots for periods of months or occasionally years. During stockpiling, manure undergoes partial decomposition and drying which can lead to significant mass decrease. If stockpiles are carefully managed ensuring aeration as well as optimal water content and carbon to nitrogen ratios, manure may be composted in the process. Much of the organic matter can be mineralised or volatilised during

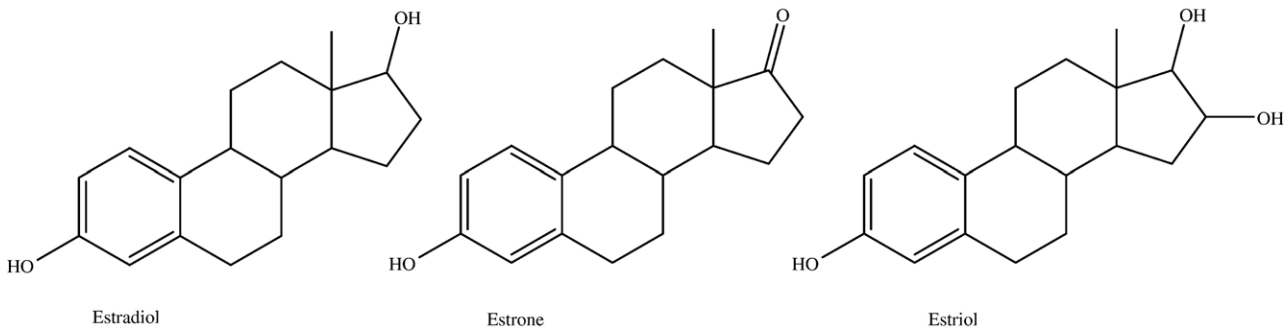

Fig. 1. Molecular structures of endogenous estrogenic steroidal hormones.